

## CORRECTION

## Open Access

# Correction: Testing the potential of a virtual reality neurorehabilitation system during performance of observation, imagery and imitation of motor actions recorded by wireless functional near-infrared spectroscopy (fNIRS)

Lisa Holper<sup>1,2\*</sup>, Thomas Muehlemann<sup>1,3</sup>, Felix Scholkmann<sup>1</sup>, Kynan Eng<sup>2</sup>, Daniel Kiper<sup>2</sup> and Martin Wolf<sup>1</sup>

## Correction

Following publication of our article [1], we realised that some of the statistical tests used were not appropriate. We have now conducted the appropriate statistical tests, and updated the relevant tables, figures five and six (Figures 1 and 2 here, respectively) and conclusions accordingly.

For both the unilateral and the bilateral groups, analyses were recalculated.

### Intra-condition differences:

- original publication [1]: paired *t*-test using means per trial for unilateral and bilateral group
- update: one-way repeated measures ANOVA using means per subject for unilateral and bilateral group

### Inter-condition differences:

- original publication [1]: one-way ANOVA using means per trial for unilateral and bilateral group

- update: one-way repeated measures ANOVA using means per subject for unilateral and bilateral group

## Conclusions

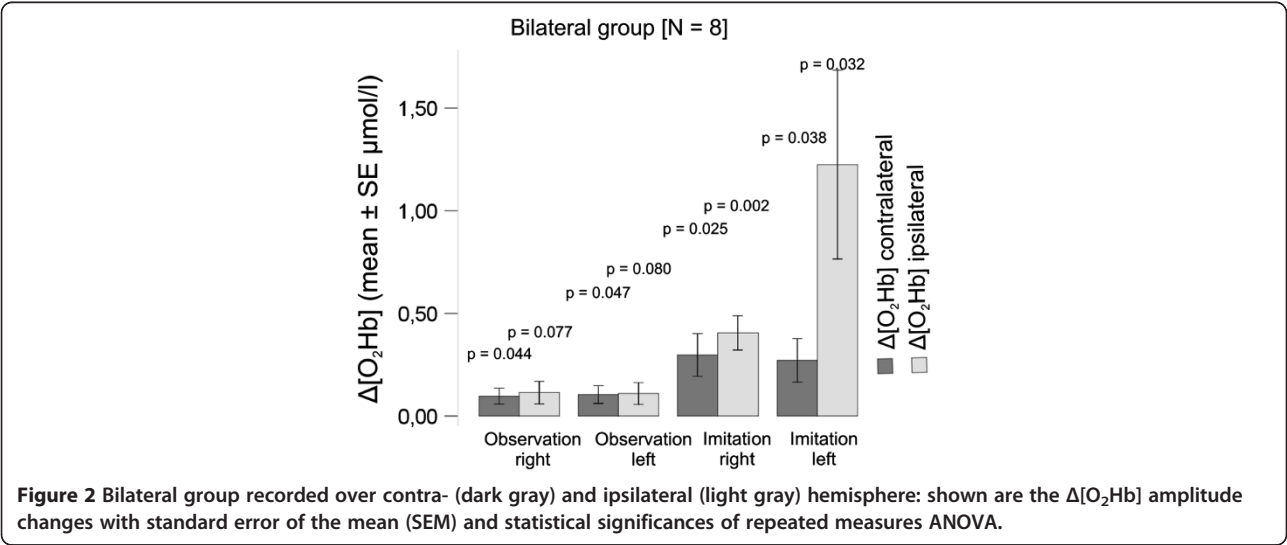
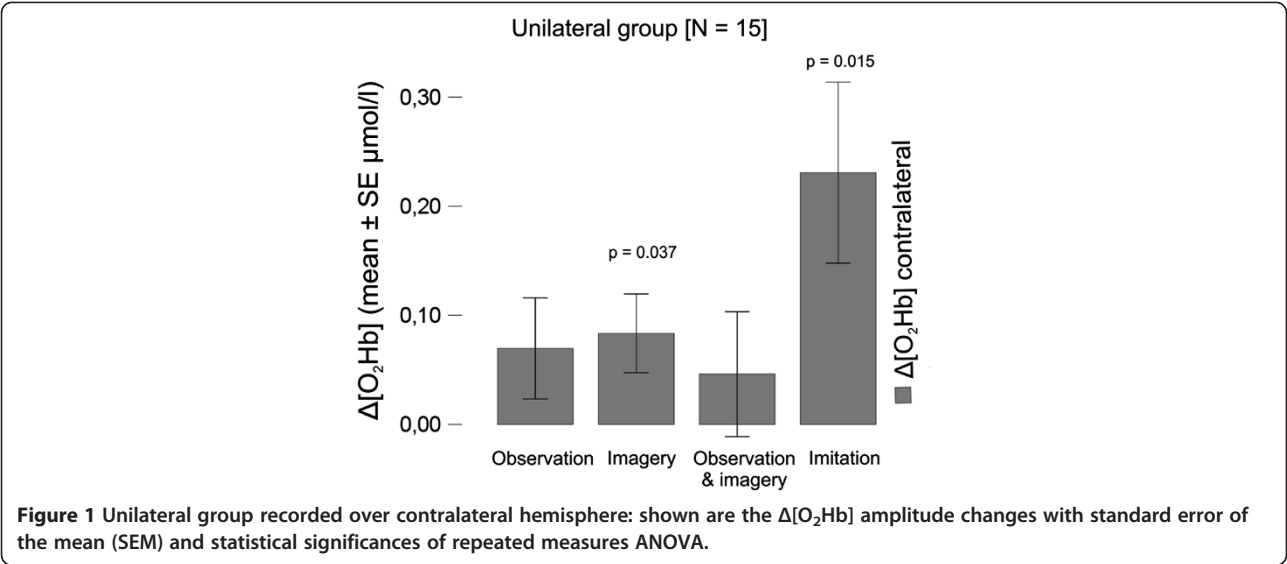
For the unilateral group (Table 1 and Figure 1), no changes in significance levels were found in  $\Delta[\text{O}_2\text{Hb}]$  signals. For the bilateral group (Table 2 and Figure 2), the main differences compared to the original publication are that the intra-condition differences ( $[\text{O}_2\text{Hb}]_{\text{rest}}$  versus  $[\text{O}_2\text{Hb}]_{\text{stim}}$ ) for the two conditions 'Observation Right' (O\_R,  $p = 0.077$ ) and 'Observation Left' (O\_L,  $p = 0.080$ ) recorded over the ipsilateral hemisphere do not reach significant level any more. Hence, the paragraphs discussing the intra-condition significances in those two conditions (sections *Observation, imagery and imitation* and *Bilateral oxygenation* of the *Discussion*) are only applicable for the contralateral hemisphere. Further, in both groups changes in significance levels were found for  $\Delta[\text{HHb}]$ . However, since the *Discussion* and *Conclusion* of the originally published article only focuses on the concentration changes found in  $\Delta[\text{O}_2\text{Hb}]$ , this aspect does not change these sections.

\* Correspondence: [holper@ini.phys.ethz.ch](mailto:holper@ini.phys.ethz.ch)

<sup>1</sup>Biomedical Optics Research Laboratory (BORL), Division of Neonatology, Department of Obstetrics and Gynecology, University Hospital Zurich, Frauenklinikstrasse 10, 8091, Zurich, Switzerland

<sup>2</sup>Institute of Neuroinformatics (INI), University of Zurich and ETH Zurich, Winterthurerstrasse 190, 8057, Zurich, Switzerland

Full list of author information is available at the end of the article



**Table 1 Unilateral group**

Unilateral group [N = 15]	Observation	Motor imagery	Observation & motor imagery	Imitation
<b>Left hemisphere (contralateral) (<math>\mu\text{mol/l} \pm \text{SD}</math>)</b>				
Mean $\Delta [\text{O}_2\text{Hb}]$	$0.06953 \pm 0.1800$	$0.0833 \pm 0.1404$	$0.0460 \pm 0.2218$	$0.2309 \pm 0.3212$
Mean $\Delta [\text{HHb}]$	$-0.0051 \pm 0.03855$	$0.0356 \pm 0.0771$	$-0.0089 \pm 0.0963$	$0.0079 \pm 0.0832$
Intra-condition, ANOVA, repeated measures				
$[\text{O}_2\text{Hb}]$ rest-stim	$p = 0.157$	$p = 0.037^*$	$p = 0.435$	$p = 0.015^*$
$[\text{HHb}]$ rest-stim	$p = 0.612$	$p = 0.097$	$p = 0.727$	$p = 0.717$
Inter-condition ANOVA, repeated measures, post-hoc-tests, Bonferroni 0.05		$\Delta [\text{HHb}]$	$\Delta [\text{O}_2\text{Hb}]$	
	O – MI	$p = 0.347$	$p = 1.000$	
	O – O&MI	$p = 1.000$	$p = 1.000$	
	O – IM	$p = 1.000$	$p = 0.286$	
	MI – O&MI	$p = 0.132$	$p = 1.000$	
	MI – IM	$p = 1.000$	$p = 0.622$	
	O&MI – IM	$p = 1.000$	$p = 0.321$	
Main effect on condition		$p = 0.253$	$p = 0.062$	

(Top) Mean signal amplitudes ( $\mu\text{mol/l} \pm \text{SD}$ ) of channels with significant concentration changes. Separate calculations for increases in  $[\text{O}_2\text{Hb}]$ , decreases in  $[\text{HHb}]$  in response to the four conditions for each group. Numbers were rounded to four decimal places. (Middle) Intra-condition statistical significance of the mean changes between  $[\text{O}_2\text{Hb}]_{\text{rest}}$  and  $[\text{O}_2\text{Hb}]_{\text{stim}}$  and  $[\text{HHb}]_{\text{rest}}$  and  $[\text{HHb}]_{\text{stim}}$  repeated measures ANOVA. (Bottom) Inter-condition statistical significance of mean changes of  $\Delta [\text{O}_2\text{Hb}]$  and  $\Delta [\text{HHb}]$  between the four conditions using repeated measures ANOVA. Shown are post-hoc tests (with Bonferroni correction); significant values ( $p \leq 0.05$ ) are highlighted by \* (observation = O, motor imagery = MI, observation & motor imagery = O & MI, imitation = IM).

**Table 2 Bilateral group**

Bilateral group [N = 8]	Observation right	Observation left	Imitation right	Imitation left
<b>Left hemisphere (contralateral) (<math>\mu\text{mol/l} \pm \text{SD}</math>)</b>				
Mean $\Delta$ [ $\text{O}_2\text{Hb}$ ]	0.1231 $\pm$ 0.1506	0.1231 $\pm$ 0.1507	0.3941 $\pm$ 0.4598	0.3715 $\pm$ 0.4289
Mean $\Delta$ [HHb]	-0.0056 $\pm$ 0.0676	-0.0408 $\pm$ 0.0915	0.0371 $\pm$ 0.1131	0.0474 $\pm$ 0.0665
Intra-condition, ANOVA, repeated measures				
[ $\text{O}_2\text{Hb}$ ] rest-stim	p = 0.044*	p = 0.047*	p = 0.025*	p = 0.038*
[HHb] rest-stim	p = 0.821	p = 0.247	p = 0.384	p = 0.084
Inter-condition, ANOVA, repeated measures, post-hoc-tests, Bonferroni 0.05				
	<b><math>\Delta</math> [HHb]</b>	<b><math>\Delta</math> [<math>\text{O}_2\text{Hb}</math>]</b>		
	O_R - O_L	p = 1.000	p = 1.000	
	O_R - IM_R	p = 1.000	p = 0.519	
	O_R - IM_L	p = 1.000	p = 0.862	
	OL_ - IM_R	p = 0.227	p = 0.486	
	O_L - IM_L	p = 0.223	p = 0.777	
	IM_R - IM_L	p = 1.000	p = 1.000	
Main effect on condition		p = 0.072	p = 0.119	
<b>Right hemisphere (ipsilateral) (<math>\mu\text{mol/l} \pm \text{SD}</math>)</b>				
Mean $\Delta$ [ $\text{O}_2\text{Hb}$ ]	0.1541 $\pm$ 0.0735	0.1957 $\pm$ 0.1957	0.4036 $\pm$ 0.2097	1.3728 $\pm$ 1.6143
Mean $\Delta$ [HHb]	-0.0113 $\pm$ 0.0334	0.0068 $\pm$ 0.0274	0.0235 $\pm$ 0.0402	0.7016 $\pm$ 1.9167
Intra-condition, ANOVA, repeated measures				
[ $\text{O}_2\text{Hb}$ ] rest-stim	p = 0.077	p = 0.080	p = 0.002*	p = 0.032*
[HHb] rest-stim	p = 0.367	p = 0.502	p = 0.142	p = 0.335
Inter-condition, ANOVA, repeated measures, post-hoc-tests, Bonferroni 0.05				
	<b><math>\Delta</math> [HHb]</b>	<b><math>\Delta</math> [<math>\text{O}_2\text{Hb}</math>]</b>		
	O_R - O_L	p = 1.000	p = 1.000	
	O_R - IM_R	p = 0.445	p = 0.014*	
	O_R - IM_L	p = 1.000	p = 0.324	
	OL_ - IM_R	p = 1.000	p = 0.015*	
	O_L - IM_L	p = 1.000	p = 0.231	
	IM_R - IM_L	p = 1.000	p = 0.710	
Main effect on condition		p = 0.384	p = 0.008*	

(Top) Mean signal amplitudes ( $\mu\text{mol/l} \pm \text{SD}$ ) of channels with significant concentration changes. Separate calculations for increases in [ $\text{O}_2\text{Hb}$ ], decreases in [HHb] in response to the four conditions for each group. Numbers were rounded to four decimal places. (Middle) Intra-condition statistical significance of the mean change between [ $\text{O}_2\text{Hb}$ ]<sub>rest</sub> and [ $\text{O}_2\text{Hb}$ ]<sub>stim</sub> and [HHb]<sub>rest</sub> and [HHb]<sub>stim</sub> using repeated measures ANOVA. (Bottom) Inter-condition statistical significance of mean changes of  $\Delta$  [ $\text{O}_2\text{Hb}$ ] and  $\Delta$  [HHb] between the four conditions using repeated measures ANOVA. Shown are post-hoc tests (with Bonferroni correction); significant values ( $p \leq 0.05$ ) are highlighted by \* (observation left = O\_L, observation right = O\_R, imitation left = IM\_L, imitation right = IM\_R).

Received: 1 February 2013 Accepted: 1 February 2013  
Published: 8 February 2013

## Reference

1. Holper L, et al: Testing the potential of a virtual reality neurorehabilitation system during performance of observation, imagery and imitation of motor actions recorded by wireless functional near-infrared spectroscopy (fNIRS). *J Neuroeng Rehabil* 2012, **7**:57.

doi:10.1186/1743-0003-10-16

**Cite this article as:** Holper et al.: Correction: Testing the potential of a virtual reality neurorehabilitation system during performance of observation, imagery and imitation of motor actions recorded by wireless functional near-infrared spectroscopy (fNIRS). *Journal of NeuroEngineering and Rehabilitation* 2013 **10**:16.

**Submit your next manuscript to BioMed Central and take full advantage of:**

- Convenient online submission
- Thorough peer review
- No space constraints or color figure charges
- Immediate publication on acceptance
- Inclusion in PubMed, CAS, Scopus and Google Scholar
- Research which is freely available for redistribution

Submit your manuscript at  
www.biomedcentral.com/submit

